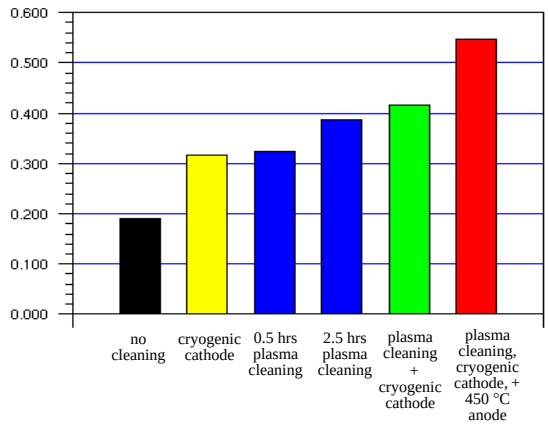
September 1994 Highlights of the Light Ion Inertial Confinement Fusion Program



Surface cleaning has dramatically improved lithium ion production efficiency on SABRE.

Two PBFA-II shots in September suggested that anode plasma is a major contributor, compared to cathode plasma, to the non-lithium current in the diode. At the IAEA Conference in Spain we summarized our progress in diagnosing lithium hohlraum experiments, improving lithium ion production efficiency, and assessing methods to transport ion beams over several meters.

We increased the lithium production efficiency on the SABRE extraction ion diode by a factor of 2.5 using surface cleaning techniques, as shown in the figure. The principal cleaning methods are RF and DC plasma discharges. Recontamination of the anode is limited by rapid heating to 200 to 600 °C, thereby reducing the surface sticking coefficient and stimulating thermal desorption. The rapid heating is accomplished with a unique inductive heating system developed at Sandia. Cooling cathodes to about -200 °C delays formation of cathode plasma. Implementation of these techniques on PBFA II is expected to have a dramatic impact in increasing lithium beam output, intensity on target, and hohlraum temperature.

General Atomics reviewed designs for new PBFA-II hardware to provide a clean lithium emission surface and consulted on DC glow discharge cleaning of the entire center section. A residual gas analyzer will measure the efficacy of glow discharge cleaning and, in addition to the systems on SABRE, titanium gettering will provide differential vacuum pumping of the liberated contaminants.

We hosted a two-day workshop in Albuquerque to assess the physics of ion beam transport for a common ion driver. This is the first of three working groups proposed by the Tri-Lab (SNL, LBL, LLNL) common ion driver group to examine the possibility of a single LMF/ETF that would use middle-weight ions to produce high yield and energy to satisfy both defense and energy missions. There was considerable interest in self-pinched transport, and a self-pinched demonstration experiment is being proposed for SABRE or Gamble II. The Tri-Lab transport group will prepare a white paper based on the results of this workshop, and the results will also be presented at the IAEA meeting on Drivers for ICF in November in Paris.

A list of possible research topics for collaboration with the Russians was developed and communicated to DOE. These projects include simulation of high yield target performance with computer codes, developing technology to accelerate ions in multi-stage diodes and to scale plasma opening switches to higher current, developing methods to couple more power to an ion diode, evaluating target experiments with magnetically insulated fuel, and fabricating targets with doped and graded-density foams.

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